REMARKS

Claims 1 and 14 have been combined and claim 1 further changed for increased clarity. Claim 1 had stated that the pressing formed an oriented product which necessarily meant orientation had increased. The additional change makes this inherent change explicit. To the extent further basis is need, attention is respectfully drawn to page 4 of the application.

Other claims have been amended for increased clarity to state that what is meant by flat is sheet-shaped. See, e.g., page 9.

The rejection on the grounds of double patenting over the '503 patent in view of Kingery has been rendered moot by the submission herewith of a terminal disclaimer.

All claims have been rejected under 35 U.S.C. § 103 over Hirao in view of Kingery or alternatively, over Hirao and Kingery in view of Kawai and Adachi. This rejection is respectfully traversed.

Conventionally, a ceramic laminate is produced by laminating ceramic green sheets, press bonding the sheets to one another and firing the resulting stack. In such a method, the pressing is such that the area of the respective grain sheets in the direction of perpendicular to the pressing axis are prevented from increasing and the crystal grains of the ceramic are not oriented. As shown in the table on page 3, pressing under these conditions does not increase orientation. While alternative methods which produce oriented ceramics are known, those methods are generally expensive and unsuited for mass production. The present Applicants discovered that an oriented product could be produced by the process which is that set forth in the claims of the present application.

The Hirao patent discloses a method in which a silicon nitride raw material powder and beta-silicon nitride single crystals in raw-like form are combined, formed into a slurry which is converted into sheets, stacked under pressure and then sintered. There is no teaching or suggestion that the orientation degree can be changed, as in the present invention. That change is a necessary consequence of the claimed method. As the Examiner has acknowledged, Hirao does not teach or suggest use of a metal mold.

In an attempt to overcome this deficiency, the rejection relies on Kingery but it is respectfully submitted that such reliance is misplaced for at least three reasons. First, the sentence on page 10 to which reference has been made refers to compaction of a "powder" and not a sheet product using a metal die. Secondly, the same paragraph teaches away from use of a metal mold in that it says use of a metal mold leads to pressure gradients and a resulting variation of density, which during sintering leads to a variation in shrinkage and a loss of tolerances, and recommends use of a rubber mold. Third, the claims here call for the sheet product to be spaced apart from a sidewall of the metallic mold but the mere reference to a metal mold does not even hint about any such positioning. To the contrary, Kingery indicates a problem arises because of the forces of the powder against the die wall, which indicates the powder is not spaced apart from the sidewall.

It is not possible to manipulate the combined teachings of Hirao and Kingery, even using impermissible hindsight, and realize the claimed invention. Any such combination must be further changed and there is nothing in the art to suggest how or to motivation the skilled person to make the necessary changes. Clearly, the claimed invention is not obvious.

The Office Action asserts that Hirai's pressing to a particular thickness inherently increases the area. It is respectfully submitted this assertion is not valid

because any assertion of inherency can only be based where there is certainty, i.e., there is one and only one possibility. That is not true here. First, while material must move "somewhere", the assertion presupposes, without factual basis, that the "somewhere" is such that the area must expand. But the mold has a fixed area and Kingery teaches the powder abuts the sidewalls of the mold. Pressing will not change the mold's fixed area. Secondly, it is respectfully pointed out that heat and pressing can serve to drive off air in the sheets or trapped between sheets or drive off the binder in the sheets, as Hirao teaches at col. 4, lines 59-60. The scientific law "Conservation of Mass" is not to the contrary since binder and air are being removed from the system creating voids into which the powder can move. Those voids constitute the "somewhere", preserving the powder's mass but reducing the volume occupied by the mass. Hirao's actions may densify the sheets by reducing their thickness, but that does not necessarily mean that "the area of a plane perpendicular to the pressing axis of the product is increased compared to that before the pressing", as recited in claim 1 of this application. Nothing in Hirao suggests increasing the area of that plane.

The Office Action proposes an alternative basis which is that Kingery teaches pressure is a result effective variable and it would be obvious to optimize it. While Kingery may teach pressure effects the density of the compact, and it might be obvious to vary the pressure to optimize density, that still does not suggest the perpendicular area (as opposed to the thickness) will change depending on the pressure.

The secondary references do not cure this deficiency. They only suggest the thickness can be changed but are silent with respect to area.

In addition, claims 4, 5, 6 and 8 recited that the ceramic crystal grains having a shape-anisotropy are flat with an aspect ratio of about 4 to 10. No teaching or suggestion of that aspect ratio has been noted in the references. It is proper to give a

term its broadest reasonable interpretation, but rods, by definition, are cylindrical, not flat. Observation that rods are "lying flat" concerns how the rods are positioned rather than that their shape is flat; these claims require the ceramic to be flat. Nevertheless, to avoid a further dispute, the term "flat" has been replaced by "sheet-shape".

The secondary references do not cure the above-noted deficiencies.

The Adachi reference relates to a method of fabricating a ceramic multi-layer substrate in which a plurality of grain sheets are laminated, sandwiched between restricting green layers, pressed and fired. In an example, there was a thickness reduction. However, like the primary reference, Adachi does not relate to increasing the orientation degree, which is a consequence of the claimed method. Further, this reference does not disclose that the area in the plane perpendicular to the pressing axis of the green sheet is increased compared to that before pressing.

Kawai relates to the manufacture of a gas discharge type display panel in which a glass paste and glass green sheets are manipulated. In order to avoid the problems encountered when forming barrier ribs by a stamping process (see column 1), the patent resorts to a rolling process in which, as shown in the drawings, the glass paste is placed on a flat surface. As a roller moves across the surface of the paste, the portion of the paste in front of the roller is raised by means of the peripheral surface of the roller to form blanks. As a consequence of this procedure, an oriented formed product as in the present invention is not realized. The barrier rib blanks may be oriented in the direction that the sheet moves but they will not be oriented sufficiently in the perpendicular direction to the movement. Further, the barrier rib blanks realized do not have a reduced thickness but, quite to the contrary, have an increased thickness as can be seen in the drawings.

The process of the present invention compared to the prior art is shown in Figures 1 and 2 of this application. In Figure 1, the stacked laminate is placed in the mold and the relative size of the mold cavity and the stack are such that the area perpendicular to the pressing direction can be increased. In the TGG method of Figure 2, the stack and size of the cavity are such that no increase in area is possible. Tables 3 and 4 and the graph of Figure 3 of the application show that the orientation degree of the samples in accordance with the invention was higher than those of the samples obtained by the TGG method. As apparent from Table 3, the electromechanical coupling coefficient (%) at thickness shear mode vibration increases with an increase in the orientation degree. This result is clearly new, as evidenced by the lack of any reference disclosing this result. Nothing in the prior art teaches or suggests that the new result achieved by the present invention was possible. In answer to the Examiner's comment, the relevance of this fact is that the claimed method, acknowledged to be new and different from the prior art, achieved results which are both surprising and unexpected. The Applicants do not understand the basis for the Examiner's assertion on page 9 that the claims encompass embodiments that do not have the new result.

None of the references, whether considered alone or in combination, suggest that pressing a sheet product formed from a ceramic slurry containing a powder of ceramic crystal grains having a shape anisotropy mixed with a ceramic raw material powder or a calcined ceramic raw material powder, or both, such that the length of the product in the direction parallel to the pressing axis is decreased and the area of the claim perpendicular to the pressing axis of the product is increased compared to those dimensions before the pressing will cause an oriented form product to be produced. The fact that such a result is achieved, as shown in the present invention, is surprising and unexpected and therefore unobvious.

In light of the foregoing considerations, it is respectfully submitted that this application is now in condition to be allowed and the early issuance of a Notice of Allowance is respectfully solicited.

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Respectfully submitted,

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